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PENSOFT

Distribution of *Thereuonema tuberculata* (Wood, 1862) (Chilopoda, Scutigeromorpha, Scutigeridae) in Hokkaido, Japan

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Abstract. *Thereuonema tuberculata* (Wood, 1862), a centipede, is distributed mainly in Asia. In Japan, *T. tuberculata* is found throughout Honshu Island and southwards, although less commonly to the north on Hokkaido. Our survey additionally showed that this species occurs commonly at altitudes of 0–540 m on Hokkaido. The northern limit of this species in Japan seems to be Nakagawa Town, Hokkaido. *Thereuonema tuberculata* was also collected on isolated islands off southwestern Hokkaido. Although previous studies have suggested distribution of *T. tuberculata* in Hokkaido is anthropogenic, it may be natural.

Keywords. Indoor invasion, Japanese house centipede, northern limit, scutigeromorph centipedes, subarctic zone, synanthropic area

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Introduction

The house-centipede order Scutigeromorpha (class Chilopoda) has about 95 species worldwide (Edgecombe 2011). Two species are known from Japan: *Thereuopoda clunifera* (Wood, 1862) and *Thereuonema tuberculata* (Wood, 1862) (Shinohara et al. 2015). In Japan, *T. clunifera* is distributed in the Kanto region and southwards, and *T. tuberculata* is known to be commonly distributed throughout the main island of Honshu and southwards. *Thereuonema tuberculata* is less commonly found on the northern island of Hokkaido (Shinohara et al. 2015). *Thereuonema tuberculata* is also known to be distributed in China, Taiwan, mainland Korea, and Jeju Island, Korea (Würmli 1975; Stoev 2002). Additionally, it has been reported as an introduced species in the United Kingdom and the United States (Barber 2011; Reeves 2017; Reeves and Miller 2022).

The western part of the Oshima Peninsula of Hokkaido is in a temperate zone, and the rest of Hokkaido except for the western and southern parts of the Oshima Peninsula is in a subarctic zone (Miyamoto 2009). *Thereuonema tuberculata* has rarely been reported from Hokkaido, with records only from Otaru City, Yakumo Town, Sapporo City, and Rankoshi Town (Takakuwa 1943, 1955; Takakuwa and Shinohara 1968; Tanabe 2001; Ôomote 2021). For that reason, it has been suggested that this species might occur on Hokkaido for anthropogenic reasons (Takakuwa 1955; Takakuwa and Shinohara 1968; Shinohara 1974). Here, we investigate the distribution of *T. tuberculata* in Hokkaido, Japan.

Methods

We conducted a distribution survey of *Thereuonema tuberculata* throughout Hokkaido, Japan from 2018 to 2023. Specimens from the collection in the Higashitaisetsu Nature Center (HTMNH) were also examined. All specimens were preserved in 70% or 99.5% ethanol

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and were identified under a stereomicroscope (Olympus SZ4045) according to Würmli (1975) and Barber (2011). The seventh tergite of one specimen was skinned with tweezers, and the female gonopods were excised. The whole specimen and the first tarsal segment of leg 6 were photographed with a digital camera (TG-6 Tough, Olympus), and photographs of the seventh tergite and female gonopods were taken with a single-lens reflex camera (Canon EOS Kiss X10).

Results

Order Scutigeromorpha Pocock, 1895
Family Scutigeridae Leach, 1814
Subfamily Thereuoneminae Verhoeff, 1905
Genus *Thereuonema* Verhoeff, 1904

Thereuonema tuberculata (Wood, 1862)

Figures 1, 2

New records. JAPAN, Hokkaido Prefecture – **Hokkaido Island – Okhotsk District** • Abashiri City, Minami 6 jô Higashi; 44°01′14″N, 144°16′31″E, ca. 10 m alt.; 28.VII.2021; Y. Uni leg.; inside a house; 1 ♂ • Abashiri City, Minami 6 jô Higashi; 44°01′14″N, 144°16′31″E, ca. 10 m alt.; 31.VII.2021; Y. Uni leg.; inside a house; 1 ♂ • Abashiri City, Minami 6 jô Higashi; 44°01′14″N, 144°16′31″E, ca. 10 m alt.; 7.VIII.2021; Y. Uni leg.; inside a house; 1 ♂ • Abashiri City, Minami 6 jô Higashi; 44°01′14″N, 144°16′31″E, ca. 10 m alt.; 25.VIII.2021; Y. Uni leg.; inside a house; 1 ♂ • Bihoro Town, Mitomi;

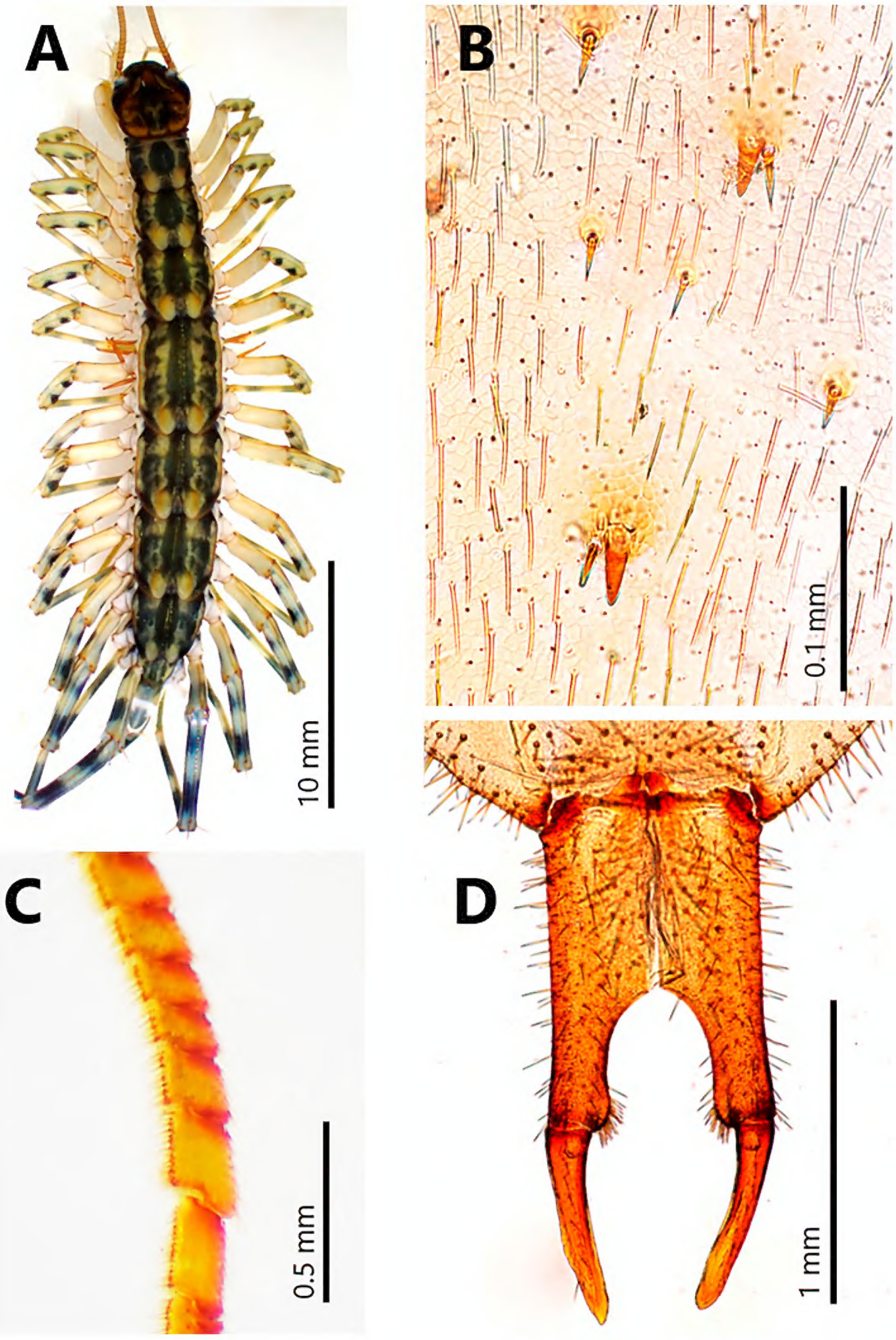

Figure 1. Adult female of *Thereuonema tuberculata* in Obihiro City, Hokkaido, Japan. **A.** Habitus, dorsal view. **B.** Part of tergite VII, dorsal view. **C.** First tarsal segment of leg 6. **D.** Gonopod of female, ventral view.

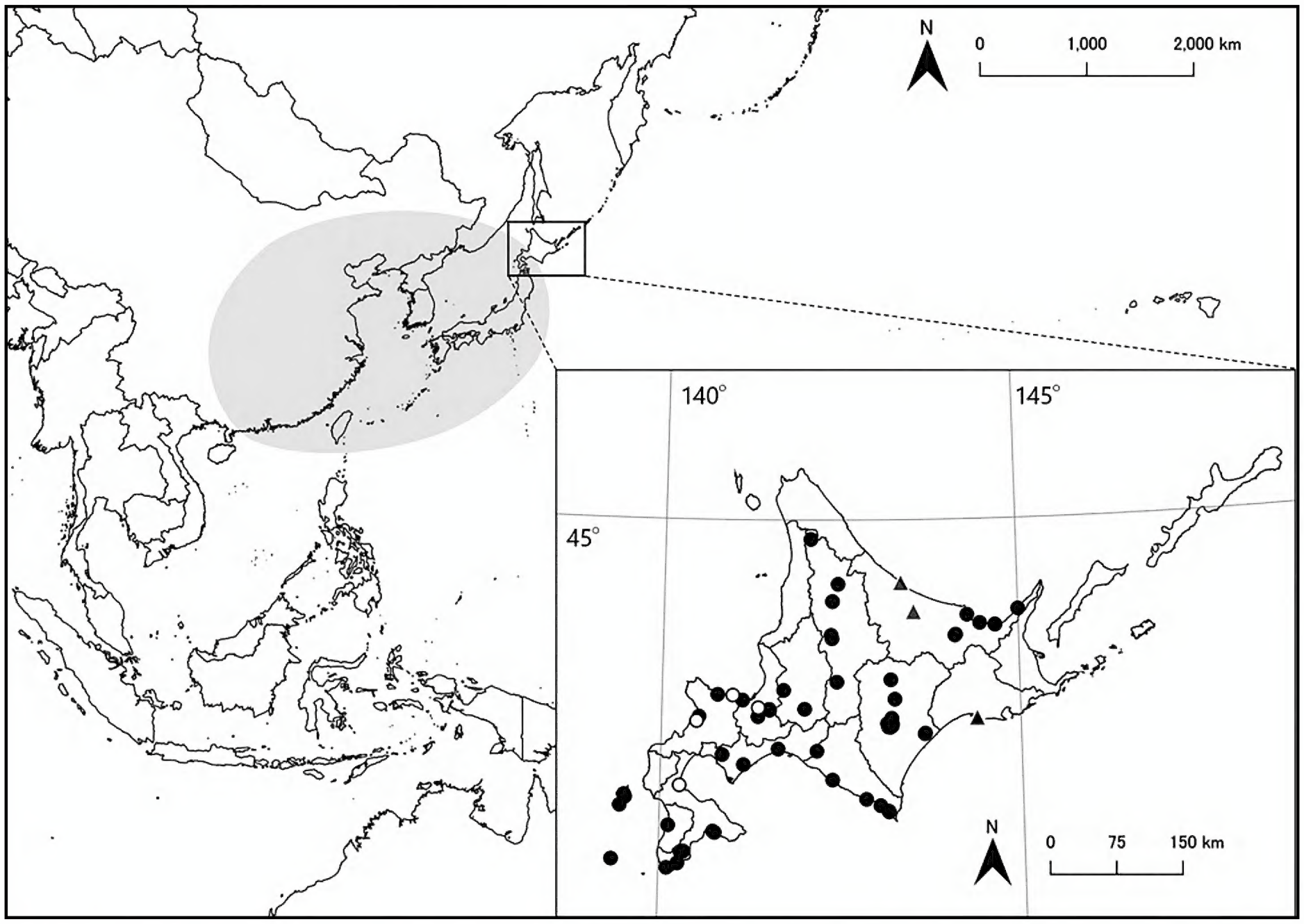

Figure 2. Distributional records of *Thereuonema tuberculata*. Closed circles - locality of specimens examined, open circles = previous records (Takakuwa 1943, 1955; Takakuwa and Shinohara 1968; Tanabe 2001; Ôomote 2021), closed triangle = eyewitness information, grey area = previous records (Würmli 1975).

43°48′40″N, 144°06′00″E, ca. 60 m alt.; 15.VII.2018; collector unknown; 2 ♂ 1 ♀ • Bihoro Town, Aoyamaminami; 43°49′11″N, 144°06′35″E, ca. 30 m alt.; 29.VIII.2021; K. Machida leg.; 1 ♂ • Shari Town, Honmachi; 43° 54′51″N, 144°39′59″E, ca. 3 m alt.; 17.VII.2021; N. Hirakizawa leg.; 1 ♂ 1 ♀ • Shari Town, Honmachi; 43° 54′40″N, 144°40′07″E, ca. 7 m alt.; 18.VII.2021; T. Murakami, N. Domoto, and N. Hirakizawa leg.; 1 ♂ 2 juv. • Shari Town, Utorokagawa; 44°04′11″N, 144°59′48″E, ca. 60 m alt.; 18.VII.2021; N. Domoto leg.; 1 ♂ 1 juv. • Shari Town, Utorokagawa; 44°04′11″N, 144°59′48″E, ca. 60 m alt.; 18.VII.2021; N. Hirakizawa leg.; 1 juv. • Koshimizu Town, Hamakoshimizu; 43°55′59″N, 144° 27′13″E, ca. 10 m alt.; 15.IX.2022; R. Wakimura leg.; 1 ♂ 1 ♀ – **Kamikawa District** • Nakagawa Town, Homare; 44°48′05″N, 142°04′01″E, ca. 20 m alt.; 12.IX.2022; N. Hirakizawa leg.; 1 ♂ 2 ♀ 1 juv. • Shibetsu City, Nishishibetsu-chô (Shibetsu City Museum); 44°10′00″N, 142°22′32″E, ca. 130 m alt.; 22.X.2021; T. Honbe leg.; inside the museum; 1 ♀ • Shibetsu City, Nishishibetsu-chô; 44°10′00″N, 142°22′32″E, ca. 150 m alt.; 10.IX.2022; R. Wakimura and H. Arimatsu leg.; 1 ♂ • Nayoro City, Nishi 6 jô Minami; 44°20′35″N, 142°27′18″E; 8.VII.2018; collector unknown; 1 ♂ • Asahikawa City, Hanasaki-chô; 43°47′12″N, 142°21′59″E, ca. 110 m alt.; 5.VII.2018; collector unknown; 4 ♂ 5 ♀ 1 ex. • Asahikawa City, Shunkodai 4 jô; 43°49′19″N, 142°21′20″E, ca. 150 m alt.; 9.XI.2021; K. Saito leg.; 1 ♀ • Furano City, Higashitorinuma; 43°20′35″N, 142°26′05″E, ca. 170 m alt.; 11.VII.2018; collector unknown; 1 ♂ 3 ♀ – **Sorachi District** • Yubari City, Fukuzumi; 43°03′58″N, 141°59′08″E, ca. 340 m alt.; 9.VII.2018; collector unknown; 5 ♂ 1 ex. • Iwamizawa City, Kitamura (Kitamura elementary school); 43°15′28″N, 141°41′25″E, ca. 10 m alt.; 18.VIII.2022; R. Kaneda leg.; 1 ♂ – **Tokachi District** • Kamishihoro Town, Nukabiragensenkyô (Higashitaisetsu Nature Center); 43°21′55″N, 143°11′37″E, ca. 540 m alt.; 4.XI.2022; A. Tanaka leg.; 1 ♀, HTMNH-48672 • Shihoro Town, Nishi 2 sen; 43°09′54″N, 143°14′40″E, ca. 200 m alt.; 9.V.2022; T. Hosaka leg.; 1 juv. • Obihiro City, Higashi 4 jô Minami; 42°55′04″N, 143°12′44″E, ca. 40 m alt.; 23.VIII.2022; N. Ohi leg.; inside a house; 3 juv. • Obihiro City, Nishi 4 jô Minami; 42°54′19″N, 143°12′03″E, ca. 50 m alt.; 13.VIII.2020; F. Yamauchi leg.; 1 ♀ • Obihiro City, Nishi 4 jô Minami; 42°54′19″N, 143°12′03″E, ca. 50 m alt.; 19.VIII.2020; R. Yamauchi leg.; inside a house; 1 ♀ • Obihiro City, Nishi 4 jô Minami; 42°54′19″N, 143°12′03″E, ca. 50 m alt.; 23.VIII.2020; F. Yamauchi leg.; 1 ♂ • Obihiro City, Nishi 4 jô Minami; 42°54′19″N, 143°12′03″E, ca. 50 m alt.; 27.VIII.2020; F. Yamauchi leg.; 1 ♂ • Obihiro City, Nishi 4 jô Minami; 42°54′19″N, 143°12′03″E, ca. 50 m alt.; 26.IV.2021; T. Yamauchi leg.; inside a house; 1 ♀ • Obihiro City, Nishi 4 jô Minami; 42°54′19″N, 143°12′03″E, ca. 50 m alt.;

27.X.2020; F. Yamauchi leg.; inside a house; 1 ♀ • Obihiro City, Nishi 4 jô Minami; 42°54′19″N, 143°12′03″E, ca. 50 m alt.; 24.VI.2021; T. Yamauchi leg.; inside a house; 1 ♂ 1 ♀ • Obihiro City, Nishi 4 jô Minami; 42°54′19″N, 143°12′03″E, ca. 50 m alt.; 27.VII.2021; R. Yamauchi and F. Yamauchi leg.; 1 ♀ • Obihiro City, Nishi 5 jô Minami; 42°53′29″N, 143°12′06″E, ca. 50 m alt.; 19.IV.2022; F. Yamauchi leg.; 1 ♀ • Obihiro City, Nishi 5 jô Minami; 42°53′29″N, 143°12′06″E, ca. 50 m alt.; 26.IV.2022; F. Yamauchi leg.; 1 ♂ 2 exs. • Obihiro City, Nishi 18 jô Minami; 42°55′21″N, 143°09′39″E, ca. 40 m alt.; data unknown; collector unknown; 2 ♀ 1 ex. • Obihiro City, Nishi 18 jô Minami; 42°55′23″N, 143°09′37″E, ca. 50 m alt.; 12.V.2021; S. Takamiya leg.; 1 ♀ • Obihiro City, Nishi 19 jô Minami; 42°52′39″N, 143°10′33″E, ca. 80 m alt.; 4.VI.2021; H. Takese leg.; 1 ♀ • Obihiro City, Nishi 22 jô Minami; 42°54′59″N, 143°08′13″E, ca. 60 m alt.; 6.IX.2020; M. Iwasa leg.; 1 ♂ • Obihiro City, Nishi 22 jô Minami; 42°54′59″N, 143°08′13″E, ca. 60 m alt.; 7.IX.2020; M. Iwasa leg.; inside a house; 1 ♀ • Obihiro City, Nishi 22 jô Minami; 42°54′59″N, 143°08′13″E, ca. 60 m alt.; 8.IX.2020; M. Iwasa leg.; inside a house, 1 ♀ • Obihiro City, Nishi 22 jô Minami; 42°54′59″N, 143°08′13″E, ca. 60 m alt.; 28.IX.2020; M. Iwasa leg.; inside a house; 1 ♂ • Obihiro City, Nishi 22 jô Minami; 42°54′59″N, 143°08′13″E, ca. 60 m alt.; 22.X.2020; M. Iwasa leg.; inside a house; 1 ♂ • Obihiro City, Nishi 22 jô Minami; 42°54′59″N, 143°08′13″E, ca. 60 m alt.; 21.IX.2021; M. Iwasa leg.; inside a house; 1 juv. • Obihiro City, Ôdôriminami, Ôdôri Park; 42°54′33″N, 143°12′22″E, ca. 40 m alt.; 30.VII.2021; F. Yamauchi leg.; 1 juv. • Obihiro City, Ôdôriminami, Ôdôri Park; 42°54′33″N, 143°12′22″E, ca. 40 m alt.; 30.VI.2022; F. Yamauchi leg.; 1 juv. • Obihiro City, Midorigaoka, Green and Flower Center; 42°54′36″N, 143°11′16″E, ca. 50 m alt.; 25.II.2022; K. Yano and K. Azuta leg.; inside a greenhouse; 1 ♂ • Obihiro City, Midorigaoka; 42°54′17″N, 143°10′52″E, ca. 60 m alt.; 28.III.2022; A. Sogawa leg.; inside a house; 1 ♀ • Obihiro City, Minami-no-mori; 42°52′53″N, 143°10′18″E, ca. 70 m alt.; 1.VIII.2020; N. Hirakizawa leg.; 1 ♂ 1 ♀ • Obihiro City, Minami-no-mori; 42°52′53″N, 143°10′18″E, ca. 70 m alt.; 24.VIII.2022; Y. Konno leg.; inside a house; 1 ♀ • Obihiro City, Ôzora-chô; 42°52′52″N, 143°09′09″E, ca. 80 m alt.; 25.IV.2021; K. Takahashi leg.; 1 ♀ • Obihiro City, Ôzora-chô; 42°52′52″N, 143°09′09″E, ca. 80 m alt.; 9.VII.2021; K. Takahashi leg.; 1 ♂ • Otofuke Town, Ryokuyôdai; 42°58′14″N, 143°11′52″E, ca. 70 m alt.; 10.IX.2021; M. Furuto leg.; 1 ♂ 4 ♀ • Otofuke Town, Ryokuyôdai; 42°58′14″N, 143°11′52″E, ca. 70 m alt.; 13.IX.2021; M. Furuto leg.; 1 ♂ 1 ♀ • Urahoro Town, Kita-machi; 42°48′50″N, 143°39′48″E, ca. 30 m alt.; 14.VI.2021; N. Hirakizawa leg.; 2 juv. • Urahoro Town, Shin-machi; 42°48′28″N, 143°39′27″E, ca. 20 m alt.; 5.X.2021; M. Mochida leg.; inside a house; 1 ♂ – **Ishikari District** • Sapporo City, Minami-ku, Monami Park; 42°59′12″N, 141°20′10″E, ca. 80 m alt.; 18.V.2021; R. Wakimura leg.; 2 ♀ • Sapporo City, Atsubetsu-ku, Atsubetsu-chô, Konopporo; 43°03′12″N, 141°29′46″E, ca. 50 m alt.; 11.VIII.2021; M. Mizushima leg.; 1 ♀ • Ebetsu City, Bunkyodai; 43°03′48″N, 141°29′28″E, ca. 40 m alt.; 15.VIII.2011; O. Suda leg.; 1 ex., HTMNH-44687 – **Hidaka District** • Erimo Town, Hon-machi; 42°00′51″N, 143°09′00″E, ca. 30 m alt.; 7.VIII.2021; N. Hirakizawa leg.; 2 juv. • Erimo Town, Hon-machi; 42°00′51″N, 143°09′00″E, ca. 30 m alt.; 7.VIII.2021; A. Sogawa leg.; 2 juv. • Erimo Town, Yamato; 42°01′17″N, 143°08′43″E, ca. 10 m alt.; 7.VIII.2021; N. Hirakizawa leg.; 3 juv. • Samani Town, Horoman; 42°04′41″N, 143°02′06″E, ca. 3 m alt.; 13.VII.2018; collector unknown; 4 ♂ 2 ♀ • Urakawa Town, Nishihorobetsu; 42°08′36″N, 142°50′24″E, ca. 2 m alt.; 16.VI.2022; N. Hirakizawa leg.; 1 ♂ 1 ♀ 3 juv. • Shinhidaka Town, Shizunaimidorichô; 42°20′33″N, 142°22′25″E, ca. 5 m alt.; 16.IV.2023; N. Yoshikawa leg.; inside a house; 1 ♀ •Biratori Town, Nibutani; 42°38′13″N, 142°09′23″E, ca. 60 m alt.; 3.VIII.2021; Y. Osada leg.; inside a museum; 1 ♀ – **Shiribeshi District** • Otaru City, Hariusu-chô; 43°09′18″N, 141°07′09″E, ca. 40 m alt.; 4.VIII.2021; S. Tsuchiya leg.; inside a garage; 1 ♀ • Yoichi Town, Tomisawa-chô; 43°12′36″N, 140°46′16″E, ca. 4 m alt.; 3.VII.2018; collector unknown; 1 ♀ • Iwanai Town, Mandai; 42°59′02″N, 140°30′57″E, ca. 2 m alt.; 3.VII.2018; collector unknown; 2 ♀ 1 ex. – **Iburi District** • Tomakomai City, Sankou-chô; 42°39′29″N, 141°37′09″E, ca. 10 m alt.; 1.VIII.2021; A. Kodama leg.; inside a house; 1 ♂ • Noboribetsu City, Noboribetsuonsen-chô; 42°29′45″N, 141°08′29″E, ca. 200 m alt.; 18.IX.2021; T. Shibuya leg.; 1 juv. • Sobetsu Town, Nakajima Island; 42°35′44″N, 140°50′41″E, 0 m alt.; 20.VII.2021; R. Wakimura leg.; 1 ♂ – **Hiyama District** • Esashi Town, Ubagami-chô; 41°51′58″N, 140°07′06″E, ca. 2 m alt.; 13.VIII.2021; R. Wakimura leg.; 1 juv. • Esashi Town, Ubagami-chô; 41°51′58″N, 140°07′06″E, ca. 2 m alt.; 13.VIII.2021; N. Hirakizawa leg.; 2 juv. – **Oshima District** • Hakodate City, Syowa; 41°48′41″N, 140°43′59″E, ca. 9 m alt.; 18.VII.2018; collector unknown; 4 ♂ 2 ♀ • Hakodate City, Goryokaku-chô; 41°47′53″N, 140°45′24″E, ca. 20 m alt.; 19.IX.2022; R. Wakimura leg.; 1 juv. • Matsumae Town, Matsushiro; 41°25′52″N, 140°06′30″E, ca. 30 m alt.; 12.VIII.2021; R. Wakimura leg.; 1 juv. • Fukushima Town, Fukushima; 41°28′45″N, 140°15′20″E, ca. 5 m alt.; 19.IX.2022; R. Wakimura leg.; 1 juv. • Shiriuchi Town, Yunosato; 41°35′43″N, 140°17′41″E, ca. 50 m alt.; 19.IX.2022; R. Wakimura leg.; 2 ♂ • Shiriuchi Town, Yunosato; 41°35′43″N, 140°17′41″E, ca. 50 m alt.; 13.VIII.2021; N. Hirakizawa leg.; 2 juv. – **Okushiri Island** • Okushiri Town, Akaishi; 42°08′46″N, 139°31′06″E, ca. 50 m alt.; 24.VII.2021; S. Inagaki leg.; 1 ♀ • Okushiri Town, Akaishi; 42°08′45″N, 139°30′56″E, ca. 10 m alt.; 28.VII.2021; S. Inagaki leg.; 1 ♂ 1 ♀ • Okushiri Town, Akaishi; 42°08′46″N, 139°31′06″E, ca. 10 m alt.; 1.VIII.2021; S. Inagaki leg.; 1 ♂ • Okushiri Town, Okushiri or Akaishi; 28.VII.2021; S. Inagaki leg.; 1 ♂ 2 ♀ • Okushiri Town, Okushiri; 42°10′21″N, 139°30′14″E, ca. 60 m alt.; 31.VII.2021; F. Suzuki leg.; 1 ♀ • Okushiri Town, Aonae; 42°03′41″N, 139°26′53″E, ca. 20 m alt.; 2.VIII.2021; S. Watabe leg.; 1 juv. – **Oshima-ôshima**

Island • Oshima-ôshima; 41°30′34″N, 139°21′16″E; 30.VII.2021; S. Hori leg.; crack of rock; 1 ♀.

Eyewitness information. Japan, Hokkaido Prefecture– **Hokkaido Island – Okhotsk District** • Mombetsu City, Shiomi-chô; 44°21′26″N, 143°21′07″E; Y. Sudo obs. • Engaru Town; 44°03′37″N, 143°31′14″E; N. Taguchi obs. – **Kamikawa District** • Takasu Town; 43°51′22″N, 142°21′35″E; K. Saito obs. – **Kushiro District** • Kushiro City, Midorigaoka; 42°59′06″N, 144°24′14″E; S. Kitada obs. • Kushiro City, Chiyonoura; 42°58′04″N, 144°23′19″E; S. Kitada obs.

Identification. All specimens obtained were identified as *T. tuberculata* based on the appearance of numerous long, spike-like spiculae on the tergites (Fig. 1B), the absence of a pair of spine-bristles at the distal end of the first tarsal segment of the fifth or sixth to fourteenth legs (Fig. 1C), and the morphology of the female gonopod (Fig. 1D).

Discussion

Neither *Thereuonema clunifera* nor *Scutigera coleoptrata* (Linnaeus, 1758), widely distributed worldwide, was found in our survey. It is likely that *T. tuberculata* is the only scutigeromorph centipede present on Hokkaido. *Thereuonema tuberculata* has been previously recorded from only two cities and two towns in southwestern Hokkaido (Fig. 2; Table 1), but our survey shows that it is distributed in almost all areas of Hokkaido at altitudes between 0 and 540 m. The species was found mainly in human-influenced environments such as houses, schools, roadside stations, and parks. It was also collected on the lacustrine Nakajima Island (Toya Lake, Iburi District), as well as Okushiri Island and Oshima ôshima Island (Fig. 2).

Although previous studies have suggested the distribution of *T. tuberculata* in Hokkaido is anthropogenic (Takakuwa 1955; Takakuwa and Shinohara 1968; Shinohara 1974), our data suggest it may also be naturally occurring. However, despite surveys and interviews, no *T. tuberculata* were found in Wakkanai City, Sarufutsu Village, Hamatombetsu Town, or Horonobe Town on the northern tip of Hokkaido 30–90 km north of Nakagawa Town, or in Akkeshi Town, and no records of *T. tuberculata* were found in the northern territories of Hokkaido (Iturup Island, Shikotan Island, Kunashir Island, Habomai Islands). Thus, the northern limit of this species in Japan seems to be Nakagawa Town (44°48′06″N).

Table 1. Previous distributional records of *Thereuonema tuberculata* in Hokkaido, Japan.

Locality	Reference
Otaru City	Takakuwa (1943, 1955); Takakuwa and Shinohara (1968)
Sapporo City	Tanabe (2001)
Rankoshi Town	Ôomote (2021)
Yakumo Town	Takakuwa and Shinohara (1968)

Murakami (1956) described the life history of laboratory-reared specimens of *T. tuberculata* (as *T. hilgendorfi*), which probably came from Ehime Prefecture, Japan (although not specified). He found that *T. tuberculata* stops molting around November and overwinters in that state, and that this species has a life span of 3–4 years (Murakami 1956). Most of Hokkaido has a subarctic climate (Miyamoto 2009); for example, the mean minimum temperature in Obihiro City (south-central Hokkaido) in February 1990–2020 reached –12 °C (Japan Meteorological Agency 2023). This species was collected indoors in Obihiro City in February, suggesting that adult *T. tuberculata* overwinter in Hokkaido to avoid the cold winter temperatures.

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Author Contributions

Conceptualization: NH, TY. Data curation: NH, HN. Funding acquisition: TY, KT, NH. Investigation: RW, NH, HN, TY. Project administration: TY, NH. Supervision: TY. Visualization: NH. Writing – original draft: NH. Writing – review and editing: TY, KT, NH, HN, RW.

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